Source Assessment and Remedy Program Lagoons 1 and 2

Bound Brook, N.J. Plant

CYANAMID

American Cyanamid Company
Wayne, New Jersey

December 1982

O'BRIEN & GERE

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December 22, 1982

Dr. Ray L. Hillard
Technical Director
American Cyanamid Company
Bound Brook, NJ 08805

Re: NJDEP Lagoons 1 and 2
Remediation Report

File: 2456.001 #2

Dear Dr. Hillard:

We are pleased to submit our report on the priority listing of sewers, entitled "Source Assessment and Remedy Program - Lagoons 1 and 2."

This report fulfills the requirements outlined in Section D-2a of the Administrative Consent Order by presenting to NJDEP the remedial actions Cyanamid will be undertaking to eliminate the groundwater contamination emanating from Lagoons 1 and 2.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

William H. Bouck, P.E.
Vice President

WHB/df
Encl.

REPORT

SOURCE ASSESSMENT AND REMEDY PROGRAM
LAGOONS 1 AND 2

BOUND BROOK, NEW JERSEY PLANT

AMERICAN CYANAMID COMPANY
WAYNE, NEW JERSEY

DECEMBER, 1982

O'BRIEN & GERE ENGINEERS, INC.
701 WESTCHESTER AVENUE
WHITE PLAINS, NEW YORK 10604

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SECTION 1

INTRODUCTION

1.01. General

American Cyanamid Company (Cyanamid) entered into an Administrative Consent Order (ACO) with the New Jersey Department of Environmental Protection (NJDEP), effective January 1, 1982, pertaining to groundwater contamination at Cyanamid's Bound Brook facility. In general, the ACO requires Cyanamid to conduct an assessment program to determine the full extent of groundwater contamination emanating from the waste storage lagoons/impoundments and wastewater conveyance/primary treatment system within the Bound Brook site. Based on the results of this assessment program, the ACO further requires Cyanamid to implement remedial actions to correct sources found contributing to groundwater contamination.

Cyanamid has retained the services of O'Brien & Gere Engineers, Inc. to complete this assessment program and to evaluate remedial actions necessary for the elimination of groundwater contamination. Additionally, Cyanamid has retained the services of Geraghty & Miller to address the hydrogeologic aspects of this program.

1.02. Requirements of the ACO - Pertaining to Lagoons 1 and 2

Requirements of this program, as presented in Section D. Source Assessment and Remedy Program, Section 2(a), are as follows:

a. Lagoon Nos. 1 and 2: Within one (1) calendar year from the Effective Date, Cyanamid shall submit a report to NJDEP detailing what actions Cyanamid will take to eliminate groundwater contamination from Lagoon Nos. 1 and 2. Within five

(5) calendar years from the Effective Date, Cyanamid shall remove the contents of Lagoons Nos. 1 and 2 or render them such that they will not impact groundwater adversely.

1.03. Purpose

The purpose of this Report is to present to NJDEP the remedial actions Cyanamid will be undertaking to eliminate the groundwater contamination emanating from Lagoon Nos. 1 and 2. This Report, fulfills the criteria set forth in the ACO.

SECTION 2

LAGOON CHARACTERIZATION

2.01. General

In the development of the characterization program for Lagoon Nos. 1 and 2, efforts were directed towards attaining information necessary for a thorough evaluation of potential remedial alternatives. This section summarizes the pertinent characterization data obtained as a result of those efforts.

2.02. Lagoon No. 1 - Characterization

Physical Description

Lagoon No. 1, built in 1956, is located adjacent to Lagoon No. 2 in the southeast quadrant of Cyanamid's Bound Brook facility. Lagoon No. 1 occupies a 2.1 acre site as shown in Figure 1. Designed for the storage of waste sludges from light oil refining processes, it has a depth of 16 feet and a working volume of 8.3 million gallons. The lagoon was constructed by excavating approximately six feet below grade and utilizing the excavated material to construct 10 foot berms above grade as shown in Figure 2. Soil borings within the berms have shown them to be constructed of silt, sand and fine gravel. From visual inspection, the berms appear to be in stable condition with no cracks or evidence of slumping. According to design drawings of this lagoon the excavated pit area is lined with a 12-inch clayey-silt layer. This was confirmed by a subsurface investigation conducted by O'Brien & Gere.

Use of Lagoon 1 ceased in 1965. During a time period from 1966-1967, the top layer, consisting of a light oil sludge (LOS), was removed leaving only the more viscous layers. At present, a water layer is maintained above the remaining sludge layers in order to limit volatilization.

Lagoon Contents

Field investigations of the lagoon contents revealed three distinct layers: designated as a water/humus layer, viscous/rubbery layer and hard/crumbly layer. This is shown schematically in Figure 2. The water/humus layer consists of decaying vegetative matter dispersed in an aqueous medium. Water is maintained on the lagoons to minimize volatilization. The viscous/rubbery (VR) layer is a soft, tacky, tarry substance, increasing in viscosity with increasing depth. The underlying hard/crumbly (HC) layer appears to be a solidified form of the overlying viscous/rubbery material, exhibiting a strongly acidic odor. The corresponding depths and volumes of each of these layers are given in Table 1. Underlying the hard/crumbly layer is approximately one (1) foot of clayey-silt liner material as discussed above.

To evaluate the chemical properties of the contents of Lagoon 1, a series of tests were performed on the various layers within the lagoon. These tests included determination of density, heating value, sulfur content, and heat energy content. The average value of these parameters computed for each layer is given in Table 2.

2.03. Lagoon No. 2 - Characterization

Physical Description

Lagoon No. 2 was built in 1947 for the storage of waste sludges resulting from light oil refining processes. Occupying a 1.7 acre site, as shown in Figure 1, Lagoon No. 2 has a depth of 13 feet and working volume of 7.1 million gallons. Use of Lagoon No. 2 ceased in 1956. Currently a water layer is maintained above the remaining sludge layers to limit volatilization. Design drawings and soil borings of the berms indicate that Lagoon No. 2 was constructed in similar fashion to Lagoon No. 1. Visual inspection of the berms indicate a

stable condition with no cracks or evidence of slumping. Subsurface investigations in Lagoon No. 2 have verified the presence of approximately 12 inches of a clayey-silt liner at the lagoon bottom.

Lagoon Contents

Field investigations revealed four stratified layers within Lagoon No. 2; a water/humus layer, a light oil sludge (LOS) layer, a viscous/rubbery (VR) layer and a hard/crumbly (HC) layer. This is shown schematically in Figure 2. The physical descriptions of the water/humus, VR and HC layers are identical to the similarly designated layers in Lagoon 1. The top portions of the LOS layer in Lagoon No. 2 are pourable and somewhat sticky, while the lower portions have a higher viscosity and become increasingly difficult to pour. The depths and corresponding volumes of each of the Lagoon No. 2 layers are presented in Table 1. As in Lagoon 1, underlying the hard/crumbly fourth layer is approximately 1 foot of clayey-silt material liner discussed above.

To evaluate the chemical properties of the contents of Lagoon 2, a series of tests were performed on the various layers within the lagoon. These tests included determination of density, heating value, sulfur content, and heat energy content. The average value of these parameters computed for each layer is given in Table 2.

2.04. Geology

Subsurface investigations in the area of Lagoon Nos. 1 and 2 indicate that unweathered shale, without severe cracking or the existence of fissures, lies approximately 20 feet below ground elevation (corresponds to a depth of 30 feet below the top of the berm). This unweathered shale is overlain by approximately 5 feet of highly weathered and decomposed shale followed by 15 feet of unconsolidated deposits consisting of dark brown silt, fine to medium sand and fine gravel.

2.05. Groundwater

The groundwater table, as shown in Figure 2, is in contact with the bottom clayey-silt material of Lagoon Nos. 1 and 2, based on groundwater elevations determined in wells around the exterior of the two lagoons as established by Geraghty & Miller, Inc. and piezometers installed in the berms by O'Brien & Gere Engineers, Inc.

Regulatory feasibility of each remedial alternative was determined by identifying all applicable Federal and State regulations pertaining to that particular technique. In cases where the remedial technique did not entirely conform to regulations or regulations did not exist, the potential of obtaining necessary permits was evaluated to determine the regulatory feasibility.

3.03. Recommended Remedial Alternative

Based on the evaluation of the remedial alternatives identified it was determined that incineration for energy recovery is the environmentally acceptable and cost-effective remedial action for Lagoon Nos. 1 and 2. Laboratory work determined that a usable fuel could be developed by blending the different stratified layers of Lagoon Nos. 1 and 2. This remedial alternative will involve the removal of the water layer to the effluent treatment plant, excavation of the lagoon contents and processing the contents through a fuel blending facility. The final product of this operation is expected to be a usable and potentially marketable fuel. Cyanamid will investigate different options to maximize this potential value. This is further discussed within the next section.

SECTION 4

REMEDIATION OF LAGOONS 1 AND 2

4.01. General

Based on the evaluation outlined in the previous sections, the environmentally acceptable and cost-effective remedial action for Lagoon Nos. 1 and 2 is incineration for energy recovery. This will be accomplished by blending the different stratified layers into various blended fuels. This action, if technically demonstrated, fulfills the requirements for remediation of the lagoons.

4.02. Implementation of Remedial Action

The tasks involved in implementing this remedial action for Lagoon Nos. 1 and 2 are as follows:

1. Regulatory review
2. Preliminary design/trial demonstration work
3. Final design and construction
4. Fuel blending and marketing operation
5. Post closure site work
6. Groundwater evaluation

The regulatory review of the remedial action for Lagoons 1 and 2 shall be initiated with the submittal of this Report to NJDEP. Subsequent to this submission, a meeting shall be scheduled between Cyanamid and NJDEP to address any questions posed by NJDEP.

Preliminary design/trial demonstration work will be undertaken for the fuel blending process to confirm that this innovative application of existing technology is technically and commercially feasible. Concurrent with this task Cyanamid will be undertaking a program to find a market for these blended fuels.

In addition, other aspects of this program will be evaluated at this time (i.e., excavation, transportation, environmental monitoring, permits, etc.). Upon completion of the above tasks, providing the program remains cost-effective, the final design and construction of this fuel blending facility will proceed. Thereupon, production of the blended fuels shall commence and continue to completion. The empty lagoons will then be leveled to surrounding grade, covered with topsoil and seeded.

The schedule of the implementation procedures, to be completed by 1986, is shown within Figure 3. This schedule is proposed and will be subject to modification during the course of this program. Any modifications will be mutually agreed upon by Cyanamid and NJDEP.

Respectfully Submitted,

O'BRIEN & GERE ENGINEERS, INC.

William H. Bouck, P.E.
Vice President

Prepared by:

Andrew N. Johnson
Steven J. Roland

Tables

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PHYSICAL CHARACTERISTICS OF LAGOON CONTENTS

LAGOON NO. 1

Layer	Average Depth (Feet)	Description	Volume (MG)	Volume (CY)	Volume (TONS)
1	2.9	Water/Humus	1.53	--	--
2	2.8	Viscous/Rubbery	1.42	7,000	7,000
3	4.7	Hard/Crumbly	2.47	13,000	13,000

LAGOON NO. 2

Layer	Average Depth (Feet)	Description	Volume (MG)	Volume (CY)	Volume (TONS)
1	0.8	Water/Humus	1.24	--	--
2	4.5	Light Oil Sludge (LOS)	2.91	14,500	13,000
3	4.3	Viscous/Rubbery	2.43	13,000	13,000
4	4.5	Hard/Crumbly	2.32	12,000	12,000

TABLE 2

CHEMICAL PROPERTIES OF LAGOON NOS. 1 AND 2

I. Average Densities (Lb/Gal)

Lagoon No.	Light Oil Sludge	Viscous/Rubbery	Hard/Crumbly
1	8.81	9.80	10.07
2	8.74	9.18	9.64

II. Average Heating Values (BTU/Gal, < BTU/Lb >)

Lagoon No.	Light Oil Sludge	Viscous/Rubbery	Hard/Crumbly
1	119,500 <13,600>	81,600 <8,300>	60,900 <6,100>
2	121,300 <13,900>	105,100 <11,500>	82,300 <8,500>

III. Average Sulfur Content (Percent by Weight)

Lagoon No.	Light Oil Sludge	Viscous/Rubbery	Hard/Crumbly
1	6.57	6.88	4.15
2	6.26	6.63	7.93

IV. Heat Energy Content (million BTU)

Lagoon No.	Light Oil Sludge	Viscous/Rubbery	Hard/Crumbly
1	--	115,800	150,300
2	352,900	255,400	190,900
Subtotal	352,900	371,200	341,200

Total Energy Content: $1,065,300 \times 10^6$ BTU

Figures

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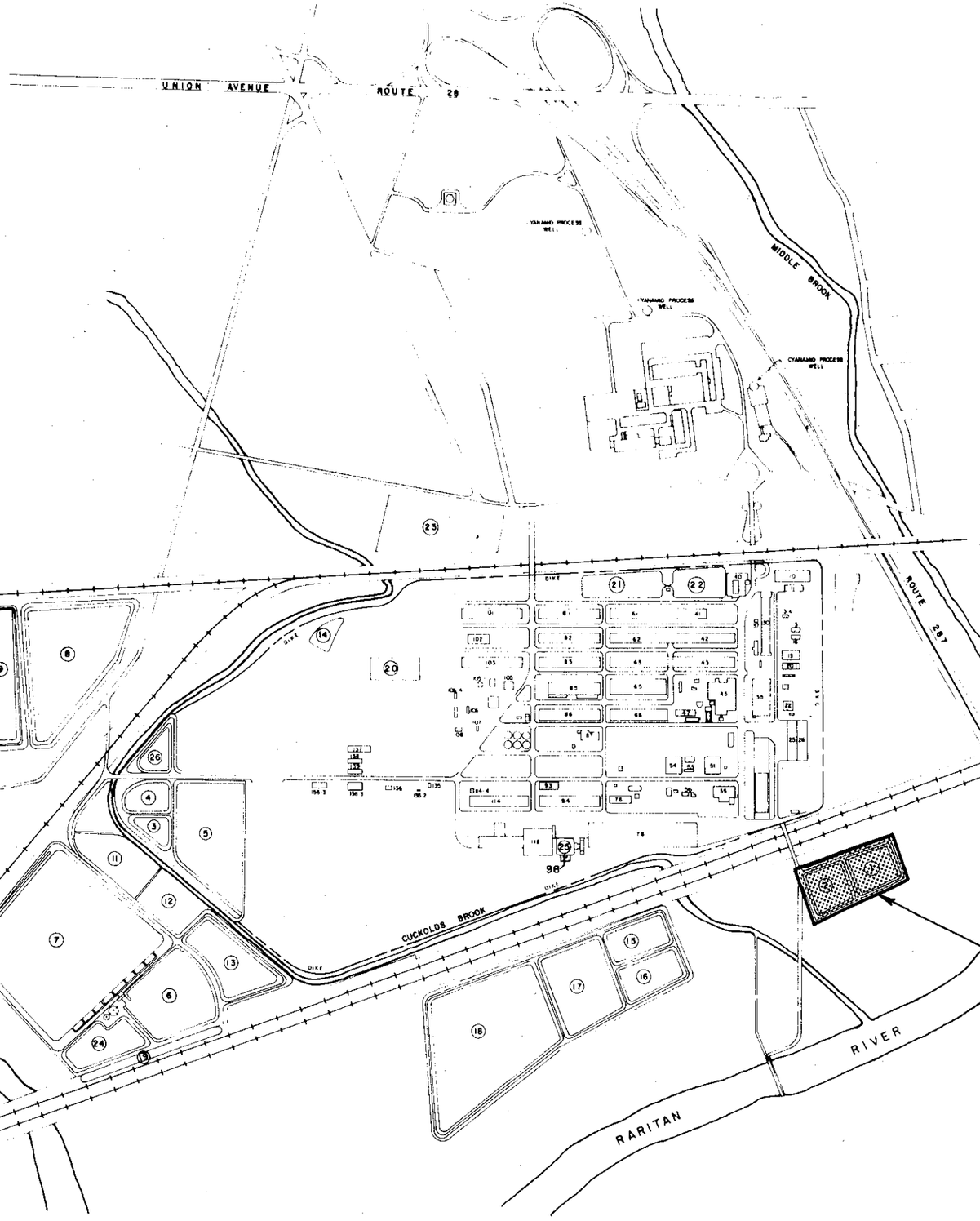
FIGURE 1



SITE PLAN

LEGEND

(5) LAGOON OR IMPOUNDMENT

AMERICAN CYANAMID

BOUND BROOK, NEW JERSEY

NOT TO SCALE

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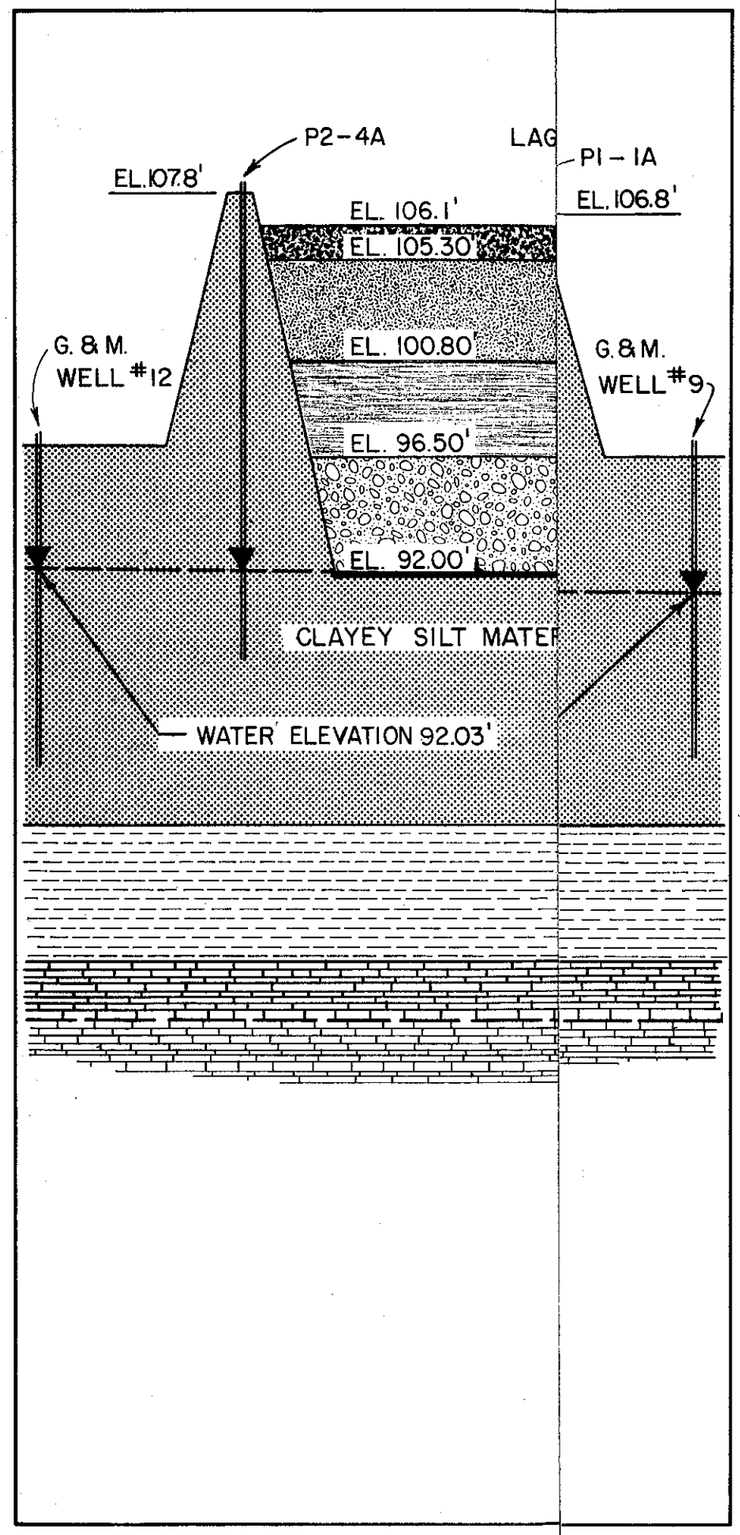
FIGURE 2



LAGOONS 1 AND 2 REPRESENTATIVE CROSS-SECTION

LEGEND

- WATER / HUMUS
- LIGHT OIL SLUDGE
- VISCOUS / RUBBERY
- HARD / CRUMBLY
- UNCONSOL. DEPOSITS
- WEATHERED SHALE
- UNWEATHERED SHALE
- WATER LEVEL IN WELL OR PIEZOMETER (WELLS READ ON JULY 29, 1982 – PIEZOMETER READ ON OCTOBER 15, 1982)

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LAGOONS 1 AND 2 IMPLEMENTATION SCHEDULE

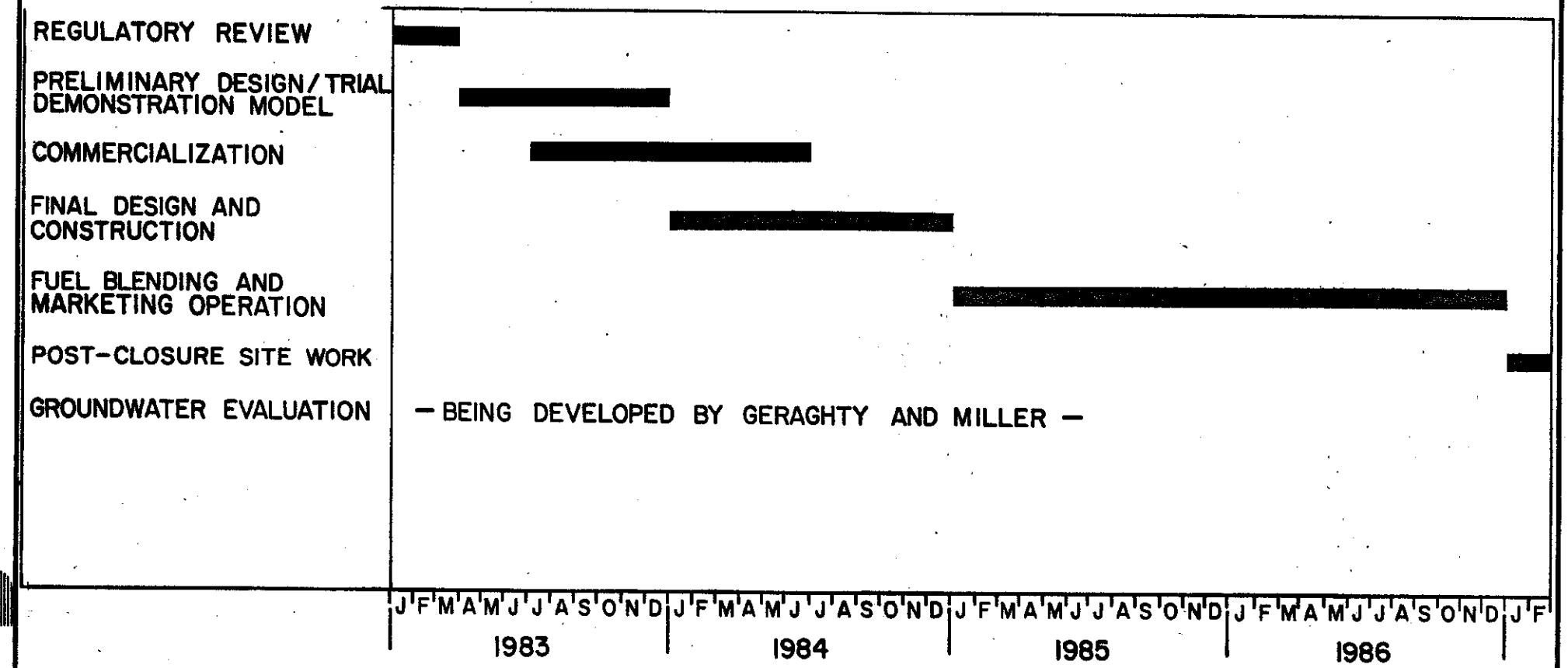

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FIGURE 3

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SUBJECT	SHEET	BY	DATE	JOB NO.
DEP Presentation	1	GMT		

Existing Conditions:

Construction Drawings indicated following:

a. Lagoon bottoms @ 92.0 (plant elevation)
b. Berms constructed of on-site materials
c. Lagoons lined with 18" of clay/soil material

Field Investigations Determined following:

a. Quantity of sludge lagoon 1 19,000 cy extending from 98.9 - 91.5 - 3 layers
b. Quantity of sludge lagoon 2 40,000 cy extending from 105.3 - 92.0 4 layers
c. liner material - ≈ 18" in both lagoons 1 and 2
   lagoon 1 91.5 - 90.0 5500 cy
   Lagoon 2 92.0 - 90.5 5400 cy
   difficult to distinguish - some staining -

determinant % H_2O % Volatile solids % ash

H/C	S/C	S/G
% H_2O/organics 97/98	% H_2O 14-19	% H_2O 14-39
% ash 2-3	% Organics 6-38	% Organics 3-
	% Ash 44-76	% Ash 73-

Project Status:- per 12/82 report remove contents of lagoons for energy recovery
- bids being taken beginning October for this project
- contractors will be directed to excavate to bottom of H/C material
- grade lagoon with existing berm material (≈ 32,000 cy) 20,000 to be moved
- seed site

Basis:- Cost-effective - Organics in form suitable for energy recovery (97%) will be removed - remaining 3% in form not suitable for energy recovery will remain
- Small % of organics remaining will when leach controlled/collected by deep wells

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SUBJECT	SHEET	BY	DATE	JOB NO.

Fall Back Positions:

1. Leave liner in and monitor with understanding that if at future date - improvement not exhibited liner will be removed

   Cost: P.W of future excavation/disposal of liner (see item 3)

2. Leave liner in and install groundwater control system to collect leachate / control groundwater in area

   Cost: well installation $250,000
   Conveyance System $200,000 - 500,000
   Annual O&M (150,000 gpd) $50,000/yr

   time frame somewhat predictable →

   P.W Cost $950,000 - $1,250,000

3. Remove liner / disposal

   P.W. Cost $1,000,000 - $2,000,000

4. Leave lagoons in-place - groundwater control (Minus $5,000,000)

   P.W Cost comparable to #2 but pumping will be for extended time

Items affecting above decisions:

1. DEP/Region 2 agreement on groundwater control

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August 3, 1983

Dr. Ray L. Hillard
American Cyanamid Company
Bound Brook, NJ 08805

Re: Lagoon 1 and 2 Closure

File: 2456.017 #2

Dear Ray:

One of the key aspects of the closure of Lagoons 1 and 2 is determining the physical limits of the contents of the impoundments and in turn the physical limits of excavation for remedial action, if it is so required. This letter will discuss how we have determined the physical limits of Lagoons 1 and 2 and will discuss the excavation of this material as it relates to remedial actions.

Construction drawings of Lagoons 1 and 2 provided by Cyanamid indicated that the final bottom elevation of these two impoundments was 92.0 (plant elevation). Additionally, these construction drawings indicated that the bottom of Lagoon 1 was lined with approximately 18 inches of a clayish/silt material. As part of our field investigation program for Lagoons 1 and 2, we sampled the bottom of both lagoons at three locations utilizing a split spoon sampler. In general, the results of this investigation verified the information on the construction drawings. For Lagoon 1, the bottom was determined to be approximately at elevation 91.50 with approximately 18 inches (elevation 90.0 to 91.5) of clayish/silt impregnated with lagoon sludges to various depths throughout this 18 inch layer. It should be noted that it is very difficult to clearly define the location where the sludge layer stops and the sludge impregnated clayish/silt layer begins. Underlying this clayish silt layer, we found sand and gravel deposits, which in some cases were slightly stained to a depth of approximately 6 to 8 inches, and in all cases exhibited an acidic odor. A similar situation was found within Lagoon 2 with the exception that the bottom of the lagoon was determined to be at elevation 92.0 and the sludge impregnated clayish/silt layer extended from approximately 90.5 to 92.0. As with Lagoon 1, the extent of sludge into this clayish silt layer varied acrossed the samples taken and again it was very difficult to distinguish a clear line of the demarcation.

As we have previously reported, the quantity of sludge within Lagoon 1 extends from elevation 98.9 to elevation 91.5, while in Lagoon 2, the sludge extends from elevation 105.3 to elevation 92.0. This represents approximately 19,000 cubic yards and 40,000 cubic yards of sludge, respectively, in Lagoons 1 and 2. The clayish/silt liner material (18 inch

thickness) found within the bottoms of Lagoons 1 and 2 have a volume of 5,500 cubic yards and 5,400 cubic yards, respectively.

In considering the extent of excavation associated with a remedial action alternative involving the removal of the materials, there are two points which should be considered:

1. Excavation of the lagoons to the bottom elevations established (Lagoon 1 - 91.5 and Lagoon 2 - 92.0) should remove in excess of 95 percent of the sludges within Lagoons 1 and 2.

2. The cost of handling and disposal of this clayish/silt layer (9,900 cubic yards) will range from approximately $100-200/cubic yards depending on the method used for disposal. The handling and disposal of this material represents a total costs of $1.0 - 2.0 million.

Based on the percentages of removal of lagoon contents achieved by excavation to the elevations 91.5 for Lagoon 1 and 92.0 for Lagoon 2, the costs associated with disposing of this clayish/silt material and Cyanamid's long term commitment to groundwater control at the Bound Brook site, it appears practical to limit the excavation for remedial action to the elevations stated above. Based on the above, the contract documents for the closure of Lagoons 1 and 2 currently being reviewed by Cyanamid, require the excavation of the contents to these elevations.

As we have discussed, if Cyanamid wants to present the above concept to NJDEP for approval, this should be undertaken and completed prior to receiving bids on this contract. We are currently planning to receive bids on this contract in early October. Additionally, based on our discussion with NJDEP at our February 1983 meeting, we would suggest that Cyanamid be prepared to discuss the ultimate fate of the groundwater plume from Lagoons 1 and 2 at this meeting with NJDEP.

If you should have any questions on the above or would like to discuss this further, please contact this office at your convenience.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Andrew N. Johnson, P.E.
Managing Engineer

ANJ/df
Encl.

cc: Dr. M. Odian, American Cyanamid Company, Bound Brook
Mr. W.J. Eckert, American Cyanamid Company, Bound Brook
Mr. R.A. Muller, American Cyanamid Company, Bound Brook
Mr. C.S. Forsyth, American Cyanamid Company, Bound Brook
Mr. G.R. Koehler, American Cyanamid Company, Wayne
Mr. J.B. Reid, American Cyanamid Company, Wayne
Mr. G.W. Lee, O'Brien & Gere Engineers, Inc.